

Application Guide

TLX Pro and TLX Pro+ Network Configuration

How to set up an IT network with TLX Pro and TLX Pro+ inverters.



The purpose of this guide is to explain how an IT network can be set up correctly with TLX Pro and TLX Pro+ inverters from Danfoss.

The following topics are included in this guide:

1. Residential systems: 1-5 inverters (1 master inverter)
2. Small commercial systems: 6-100 inverters (1 master inverter)
3. Commercial systems: 101-400 inverters (2-4 master inverters)
4. Power plants: 401-xxx inverters (5-xx master inverters)

Different plant types are distinguished by number of inverters, as categorised above. While residential systems can be monitored with standard SOHO (Small Office, Home Office) hardware, systems belonging to the other three categories require professional networking devices, as described in this application guide.

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List of Abbreviations

SOHO	Small Office, Home Office
DNO	Distribution Network Operator
FTP	File Transfer Protocol
DSL	Digital Subscriber Line
UMTS	Universal Mobile Telecommunications System
EDGE	Enhanced Data for GSM Evolution
DHCP	Dynamic Host Configuration Protocol
APIPA	Automatic Private IP Addressing
MIS	Management Information System
UL	Underwriter Laboratories Inc.
EMV	Electromagnetische Verträglichkeit (English: EMC – Electromagnetic Compatibility)
VPN	Virtual Private Network

Introductory Comments

The TLX Pro / TLX Pro+ variants in the TLX Series of Danfoss solar inverters allow the configuration of 100 units in one network, via one master inverter. This master inverter must be physically connected to the followers via an Ethernet patch cable.

If the PV system holds more than 100 inverters, it has to be divided into two or more networks with two or more masters (1 master = 99 followers). In that case, it is very important to install these two or more networks with a physical separation. The inverters in one network are not allowed to reach inverters from other networks (for example via Ping). It is similarly important to apply professional hardware to keep the ping times (answering time inside the network) between the inverters as low as possible.

If the system is small (1-5 inverters), the network traffic between the inverters, as well as the requests from the router, is not so heavy. In that case, it is not a problem for SOHO routers (Small Office, Home Office) to fulfil the requirements. If the system consists of 6-xxx inverters, it is necessary to apply professional IT hardware to fulfil all the requirements from the DNO. It is also necessary to be able to monitor the inverters reliably for many years without communication failures (in case of breakdown of IT hardware).

For large systems, special industrial Ethernet communication equipment is recommended. This equipment is tested and supported by NemaSystems Automation GmbH, a network solution partner of Danfoss.

In the following sections, it is explained which hardware is suitable for a PV plant and how to install it, as well as which IT equipment should be used to provide a stable monitoring system.

Internet Connection

As default, each system is delivered without the possibility to send data via an internet connection. If an internet connection is needed (FTP upload, email messaging), an additional DSL modem must be ordered and a DSL connection must be available on site.

UMTS / GPRS Limitation

Please note that we do not offer support for internet connections based on mobile data communication such as EDGE and UMTS.

Also, Danfoss cannot guarantee full functionality of FTP upload and does not offer support for such an installation.

1. Residential Systems: 1-5 Inverters (1 Master Inverter)

Small residential PV systems with 1-5 inverters, which are mostly used in private households, can be directly connected to your SOHO router at home.

Most common routers used in Europe:

DK	DE	FR	ES	PT	IT
Cisco, Linksys	Vodafone Easy Box	Livebox and Livebox Pro (National standard)	Alcatel-Thomson	DrayTek, D-Link	D-Link
Netgear	AVM Fritzbox, Telekom speedport		Amper (spanish brand)	Speed-Touch	Netgear
D-Link	Netgear, Cisco, D-Link, Linksys, Belkin		Linksys, D-Link, Netgear	Thompson	Linksys
Belkin				Linksys	Digicom

On these routers, a standard feature called DHCP (Dynamic Host Configuration Protocol) is usually activated. This service provides each PC and the inverters with a unique IP address (example: 192.168.1.11). If not, check the user manual of the router to find out how it can be switched on.

With these addresses, each client (inverters, PCs and printers) can be reached and they can “speak” to each other.

The inverters also support APIPA functionality (Automatic Private IP Addressing). This service is suitable to create a setup between a few inverters. Be aware that this setup is only suitable for a few inverters. If possible, use DHCP. If not, refer to the inverter manual for a description of how the static IP addresses of the inverters are set up.

1.1. Wiring Scheme

Each TLX Pro / TLX Pro+ inverter must be connected to the network via Ethernet cables through the RJ45 ports positioned on the right side of the Comm. board. Each inverter acts like a switch. The distance between two inverters may reach 100 m (based on Ethernet rules). This value depends on the mounting place of the communication cables, therefore to prevent problems, the distance between inverters should always be lower than 80 m. In the case of AC cables collated close to the communication parts, the Ethernet cables need to be shorter in order to prevent disturbances.

If a grid management device is needed, the device can also be connected to the router directly. For information about the CLX GM and how to set up this device, go to www.danfoss.com/solar.

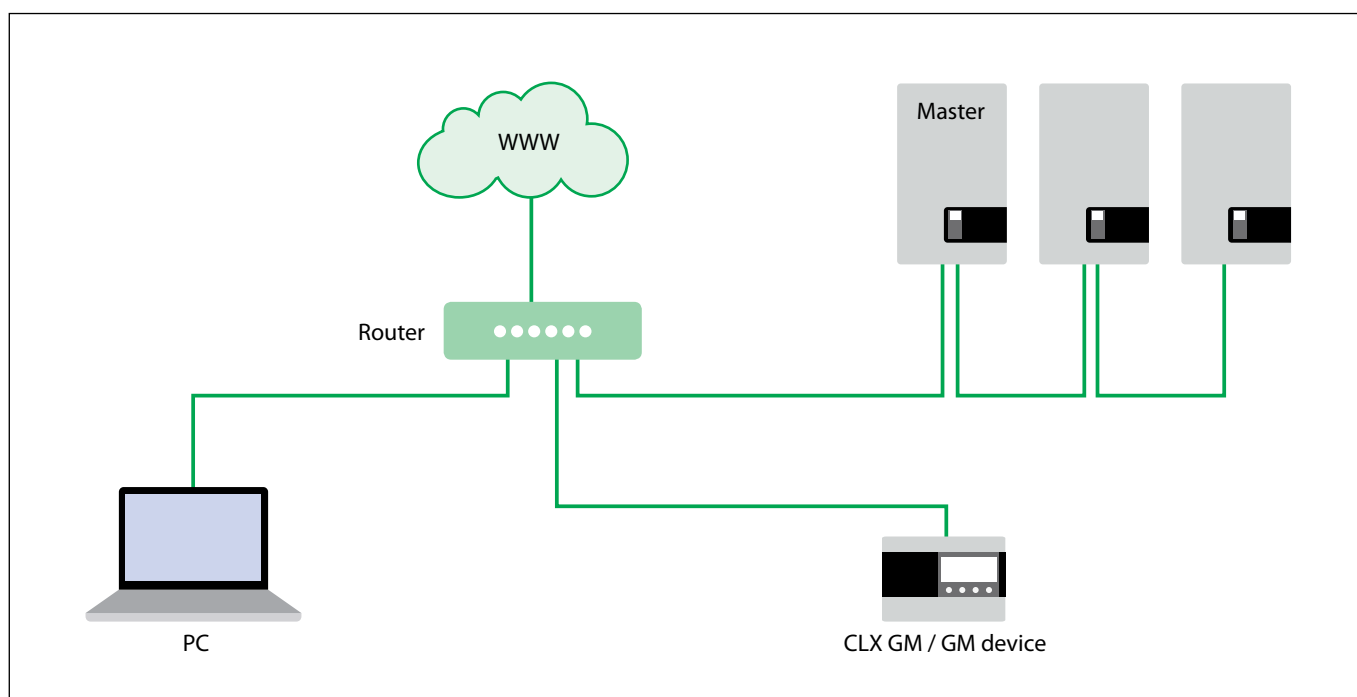


Figure 1

2. Small Commercial Systems: 6-100 Inverters (1 Master Inverter)

Systems with more than 5 inverters must be connected to professional industrial layer 2 switches to relieve the router as explained in the introduction (DHCP requests, time-outs between the master and some followers). NemaSystems Automation GmbH, offers different systems, depending on your PV plant conditions.

2.1. Information about NemaSystems Automation GmbH

NemaSystems Automation GmbH is our partner for industrial network solutions and services. For Field-Boxes, only approved network hardware from Cisco and N-TRON are used.

N-TRON Corporation develops, manufactures, and markets highly reliable industrial network products designed to solve the most demanding industrial Ethernet communication requirements for mission-critical MIS, data acquisition, and control applications. These products fulfill the needs of engineering and information technology professionals, who require Ethernet products to operate in harsh industrial environments with high throughput and minimum downtime. All products fulfil industrial requirements. Each product is UL approved and EMV (EMC) tested.

More information can be found at www.nemasystems.de
Contact details for ordering are available at the end of this document.

2.2. PV Systems, 6-100 Inverters

For these types of systems, a system called *NSY Field Solution 100* is recommended, and it can be ordered directly from NemaSystems Automation GmbH.

- IP20 with or without router (indoor)
- IP65 with or without router (outdoor)

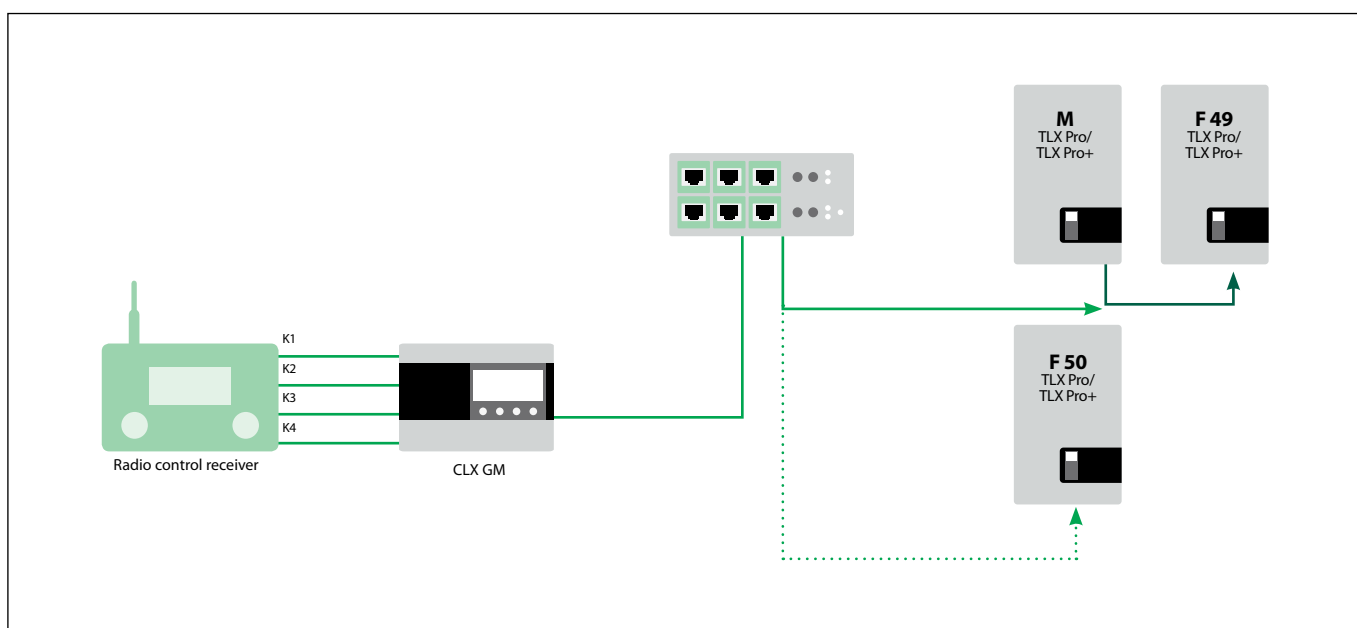
NOTE!

The system without a router is for PV plants where an internet connection with a modem already exists. If there is no IT equipment and the customer wants to have the possibility to send data via FTP upload or email, the NemaSystems solution with a router must be chosen. In addition to the NemaSystems solution, a DSL connection from the relevant internet provider is needed.

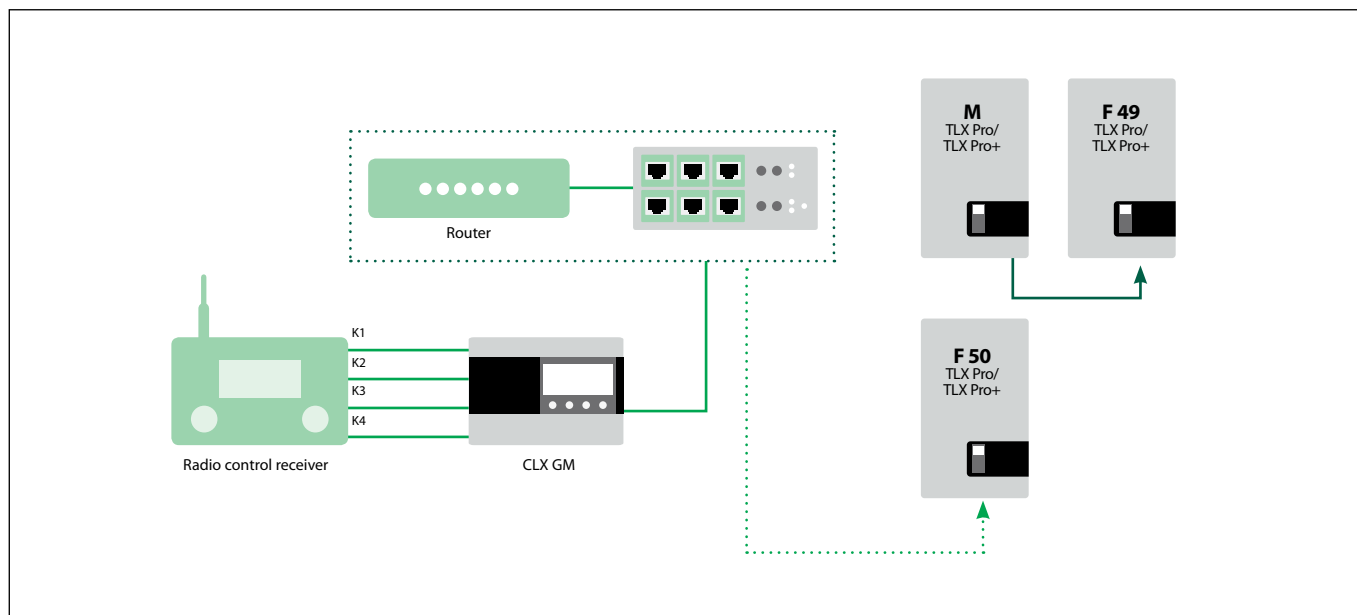
In some countries, the DNO requires that PV systems provide the possibility of controlling the output and reactive power via a radio control receiver. In that case, it is necessary to install a grid management device. This device can also be connected directly to the FieldBox specified port for such devices (CLX GM, Danfoss Grid Management device).

2.2.1. Wiring Scheme

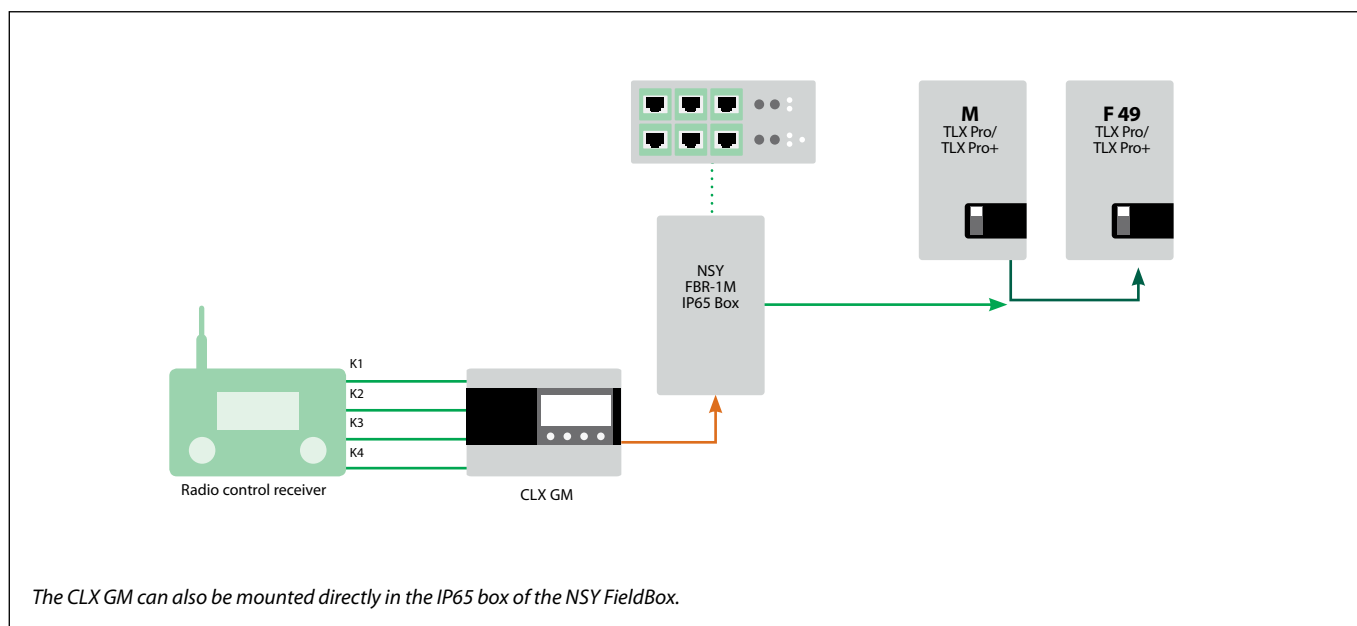
NSY-FS-100 IP20 without router (if an internet connection is not needed or a DSL modem is on site):



NSY-FSR-100 IP20 with router (if an internet connection is needed and there is no DSL modem on site; DSL connection must be available on site):



NSY-FB-100 without router or *NSY-FBR-100* with router (the same hardware mounted in a special IP65 box):



NOTE!

Standard delivery is without grid management device. A grid management device can be a Danfoss CLX GM or an equivalent third-party product. A CLX GM can be installed at a reserved place inside the IP65 Box.

3. Commercial Systems, 101-400 Inverters (2-4 Master Inverters)

Systems with more than 100 inverters must be handled like other large power plants (wind turbines, nuclear power plants, etc.). They have to be available and accessible for many years (access to control and monitoring of the units). This can be done with special IT equipment provided by NemaSystems Automation GmbH.

The system layout is always the same. It is necessary to know that a maximum of 99 inverters can be handled by one master, and for each master inverter one NemaSystems field box (*NSY-FB-X*) is needed.

To control all the units and to send signals to them, a router called *NSY-FieldBoxRoute (NSY-FBR-XXX)* is required. The router provides Ethernet fibre-ring functionality to achieve higher reliability and overcome longer distances.

At the time of purchase, the whole system is already preconfigured. Each NSY field box can be connected to 100 inverters directly (2 x 50 in one network string, or 1 x 100 in one network string) via Ethernet cable.

Example of how to select the right network equipment:

If a system consists of 245 inverters, it may be difficult to find the right hardware.

To make it as easy as possible, a complete *NSY FieldBox 300* system can be ordered. The "300" defines the number of master inverters that can be controlled with these units.

The field boxes are connected to each other via fibre optics. This technique is cheaper and much more reliable than standard copper connections. In case skills with fibre optics are lacking, NemaSystems Automation GmbH offers a list of certified partners. It is also possible to contact NemaSystems for support services. If the mounting has to be done on a very large field or on scattered rooftops for instance, the installation might be slightly more difficult than initially expected from the wiring scheme. Each field box includes an Ethernet port for special equipment like a camera or an energy meter etc.

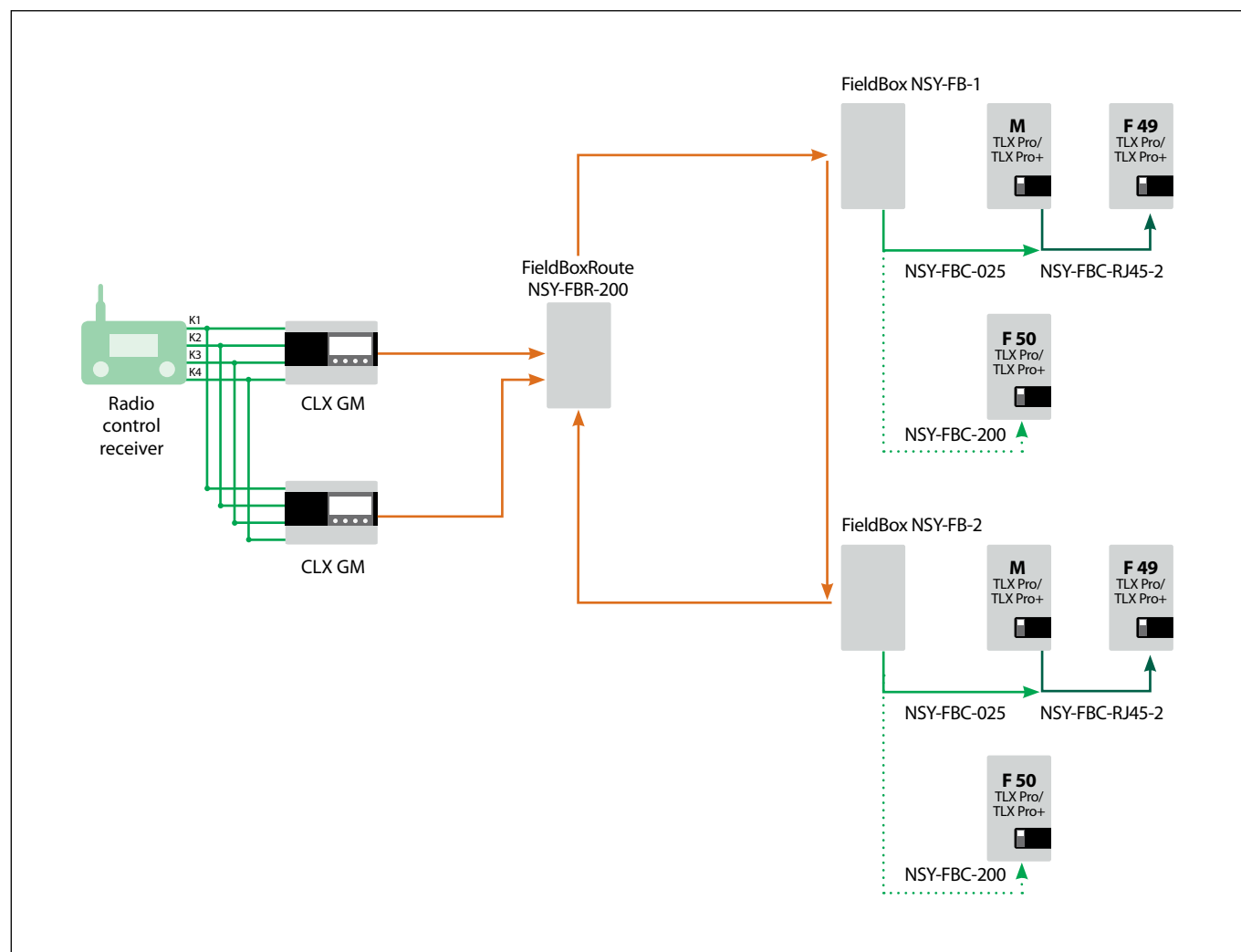
NOTE!

The grid management device is not included when a system is delivered. The grid management device is not always necessary and could also be a third-party product. If you want to use a Danfoss CLX GM for controlling the system, you must use one CLX GM unit for every master inverter in the installation. If the local electricity supplier or country regulations require a special grid management device, contact Danfoss or NemaSystems Automation GmbH for more information. The grid management device can be mounted inside the *FieldBoxRoute*.

If web portal, email messaging and/or own FTP are preferred, ensure that DSL (min. 1000) is available. Contact NemaSystems to clarify open questions before ordering equipment.

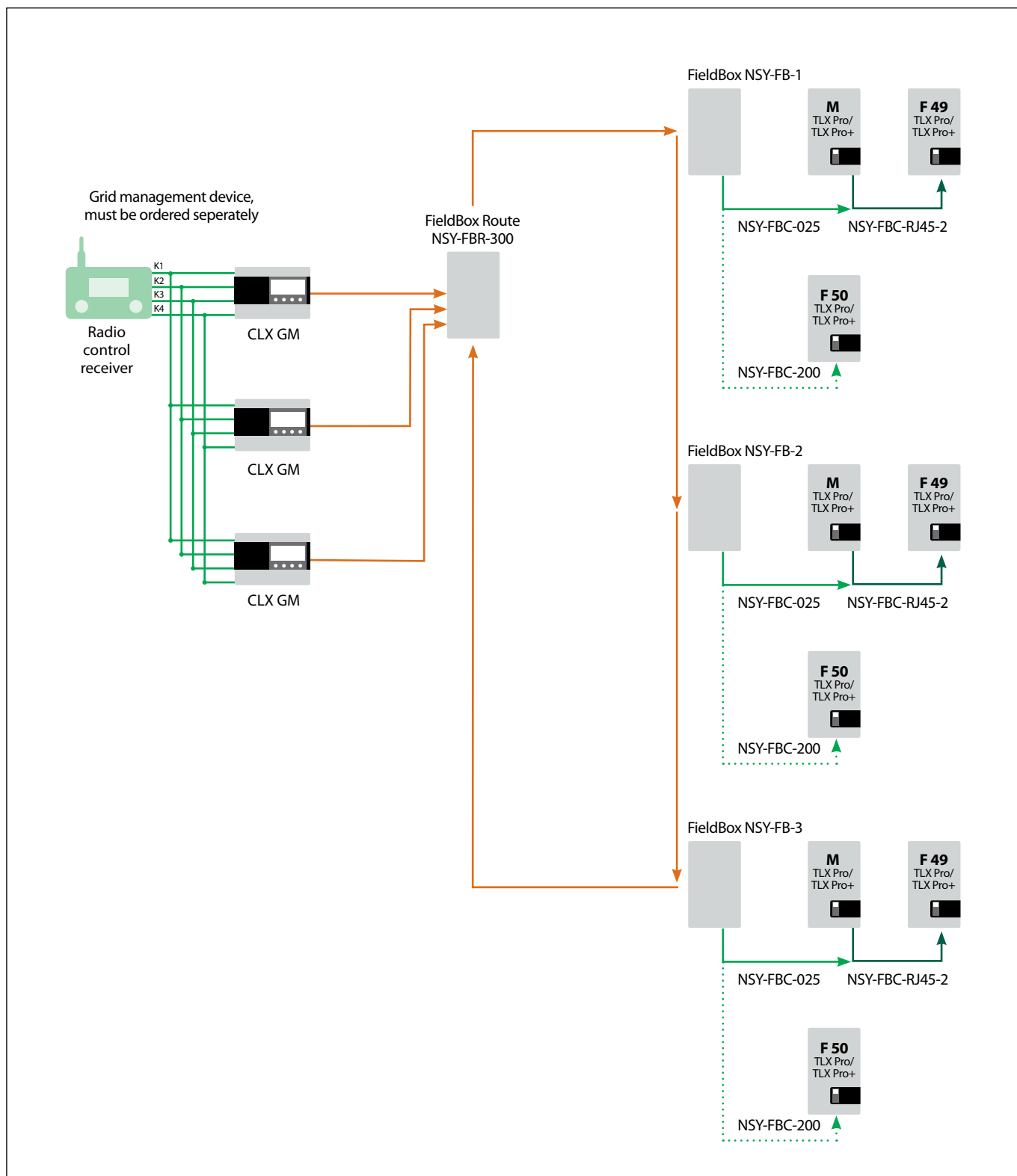
3.1. Wiring Scheme

FieldBox System 200 (2 master inverters)



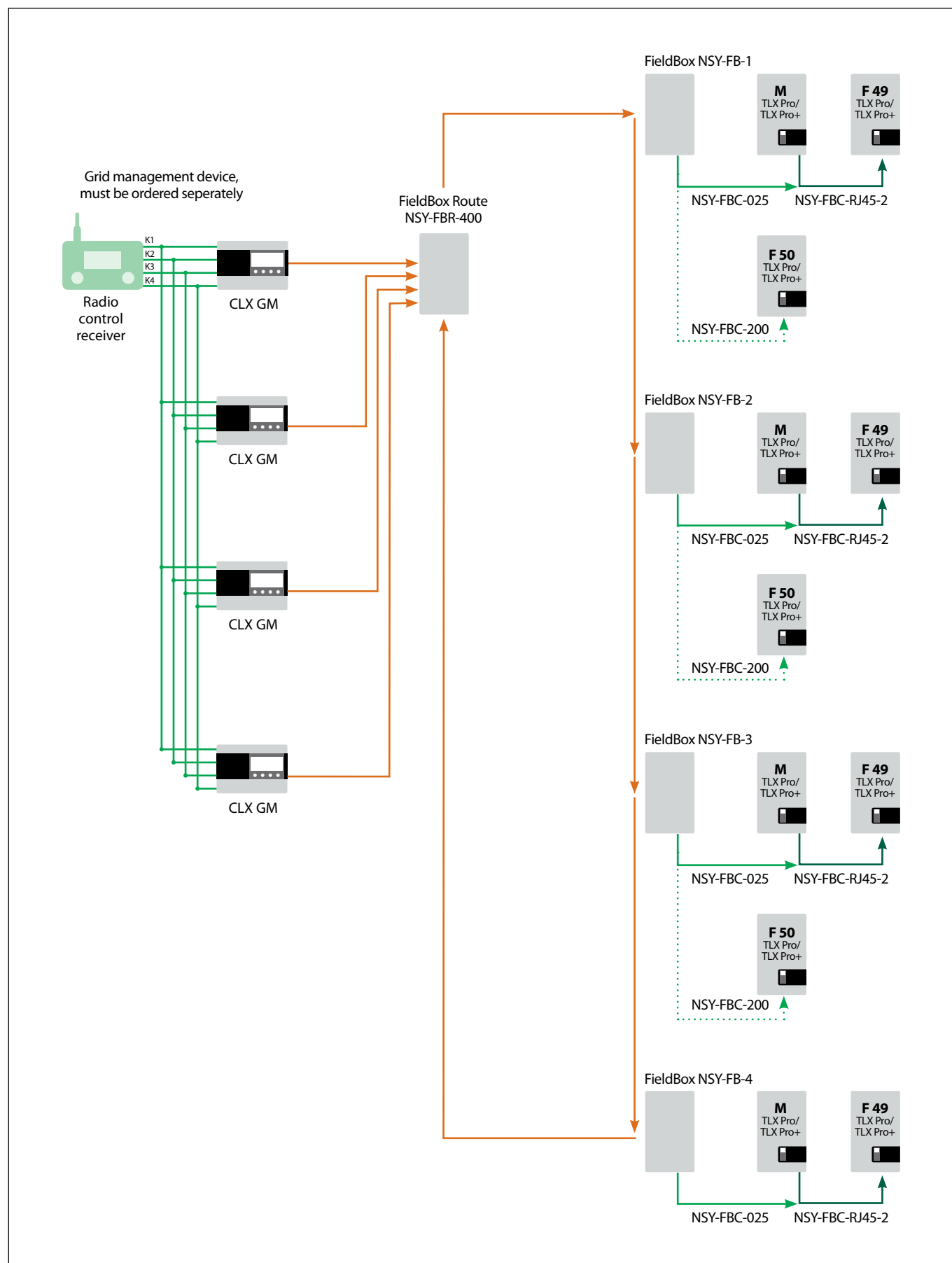
3.2. Wiring Scheme

Field Box System 300 (3 master inverters)



3.3. Wiring Scheme

FieldBox System 400 (4 master inverters)



4. Power Plants: 401-xxx Inverters (5-xx Master Inverters)

The layout for these types of systems is exactly the same as for power plants with 101-400 inverters.

Example:

If a system consists of 555 inverters, the following equipment is needed (6 masters):

"6 x FieldBox - NSY-FB-x (x = for master number)"

FieldBox NSY-FB-1

FieldBox NSY-FB-2

FieldBox NSY-FB-3

FieldBox NSY-FB-4

FieldBox NSY-FB-5

FieldBox NSY-FB-6

"1 x FieldBox Route - NSY-FBR-x00 (x = number of max. master inverters)"

FieldBox NSY-FBR-600

All these systems are without a modem (UMTS, DSL, etc.) and without a grid management device.

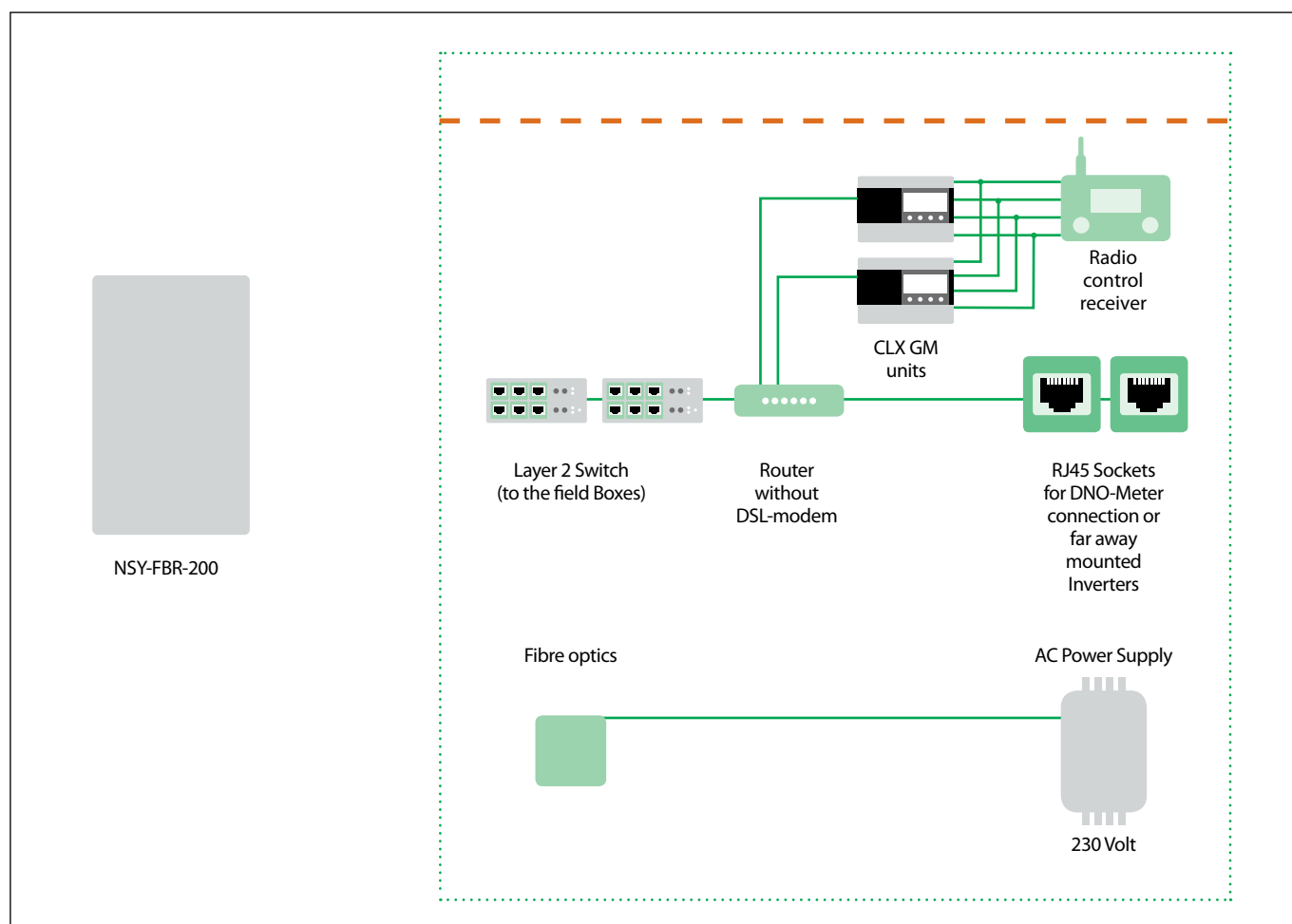
If web portal, own FTP, camera support for alarm systems etc., are preferred, contact NemaSystems for support.

5. Hardware Information

Example of a system with 2 master inverters:

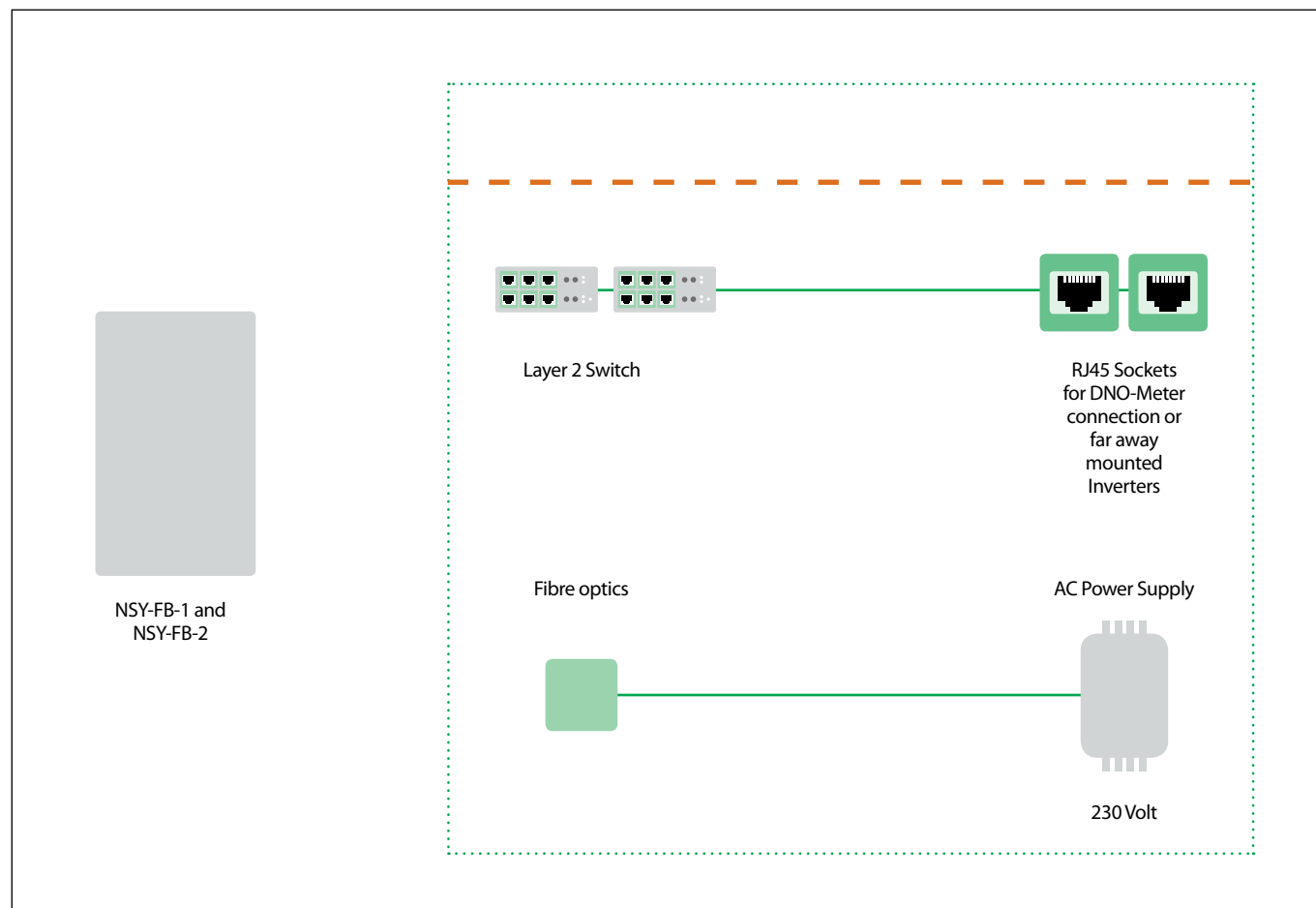
The *FieldBoxRoute*, *NSY FBR-200*, is responsible for DHCP and VPN, and it also routes the data from the grid management device(s) (if it is needed) to the inverters and from the master to the optional or

existing modem. Be aware that the router inside of the *FieldBoxRoute* is without a modem. If an internet connection is needed, order an additional DSL modem from NemaSystems Automation GmbH.



To control each master inverter, two *FieldBoxes*, *NSY FB-1* and *NSY FB-2*, are needed.
To handle all the signals from the *FieldBoxRoute* to the

master inverter and to control the traffic of the inverters between each other, the field boxes are connected via fibre optics.



All wires are marked with colours and the installation manual explains how to plug it together. It does not matter which field box system is chosen. Everything is plug-and-play.

Just add the right IP address to the individual master inverters (the IP addresses are noted inside the field boxes).

The hardware is ready to use. There is no programming work to do.

Products can be ordered by using the following address:



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